RICOH

RP502x SERIES

Step-down DC/DC Converter with Synchronous Rectifier

NO.EA-189-111124

OUTLINE

The RP502x Series are CMOS-based step-down DC/DC converters with synchronous rectifier.

Each of these ICs consists of an oscillator, a reference voltage unit, an error amplifier, a switching control circuit, a soft-start circuit, protection circuits, an UVLO circuit, and switching transistors. By adopting the synchronous rectification with built-in switching transistors, high efficient step-down DC/DC converter can be composed of only an inductor and capacitors.

As protection circuits, the current limit circuit and the latch protection circuit are built into the ICs. The current limit circuit controls the peak current of L_X at each clock cycle. Latch protection circuit maintains the built-in driver in OFF state if the load current exceeds the limit value for a certain period of time. To cancel the latch protection, disable the ICs with a chip enable circuit and then enable it again or make the power supply voltage lower than UVLO.

The setting voltage for the RP502x Series is the output voltage fixed type with built-in feedback resistance that is adjustable in 0.1V step with the accuracy of ± 1.5% or ±24mV. The packages for the ICs are WLCSP-6-P2 and DFN1616-6, which enable the high-density mounting. The switching mode for the ICs is selectable from the PWM/VFM auto switching type, which achieves the high efficiency at the light load condition or PWM fixed type, which switches at the fixed frequency.

FEATURES

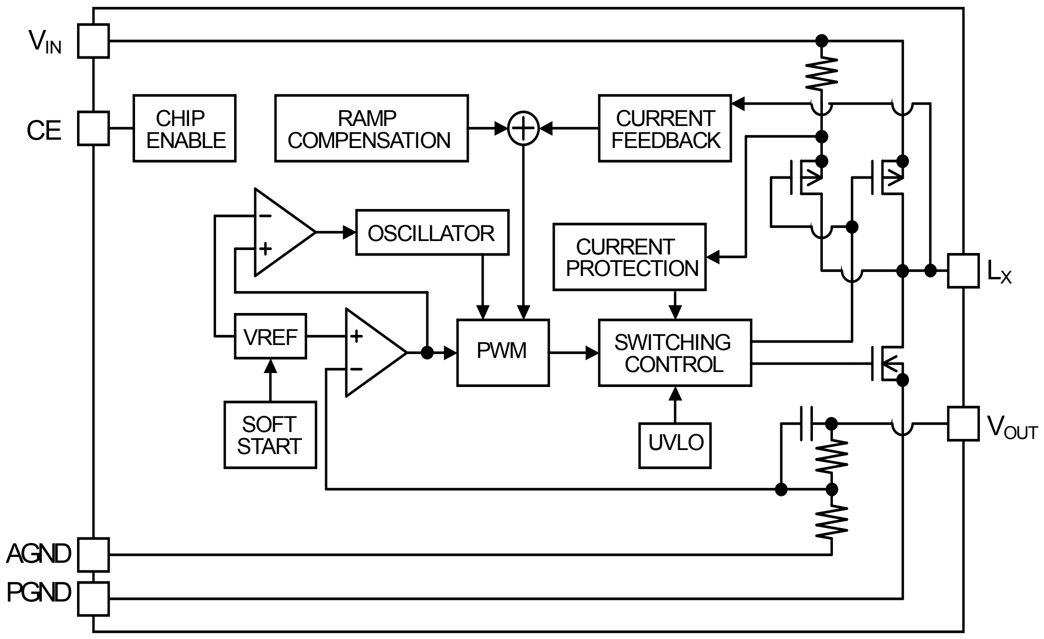
- Supply Current .... Typ. 750μA (at normal)
  Typ. 180μA (at light road)
- Input Voltage Range .... 2.5V to 5.5V(V_{OUT}≥1.0V)
  2.5V to 4.5V(V_{OUT}<1.0V)
- Absolute Maximum Ratings 6.0V
- Output Voltage Range... 0.8V to 3.3V (0.1V steps)
- Output Voltage Accuracy....................................... ±1.5% (V_{OUT}≥1.6V)
  ±24mV (V_{OUT}<1.6V)
- Oscillator Frequency .... Typ. 3.3MHz
- Maximum Duty .... Min. 100%
- Built-in Driver ON Resistance .... Typ. Pch. 0.5Ω, Nch. 0.5Ω(V_{IN}=3.6V)
- UVLO Detector Threshold..................................... Typ. 2.2V
- Soft Start Time... Typ. 0.12ms
- Lx Current Limit... Typ. 900mA(V_{OUT}≥1.2V)
  Typ. 800mA(V_{OUT}<1.2V)
- Latch type Protection Circuit .... Typ. 1.5ms
- Chip Enable Function.. "H" Active
- Packages WLCSP-6-P2, DFN1616-6

APPLICATIONS

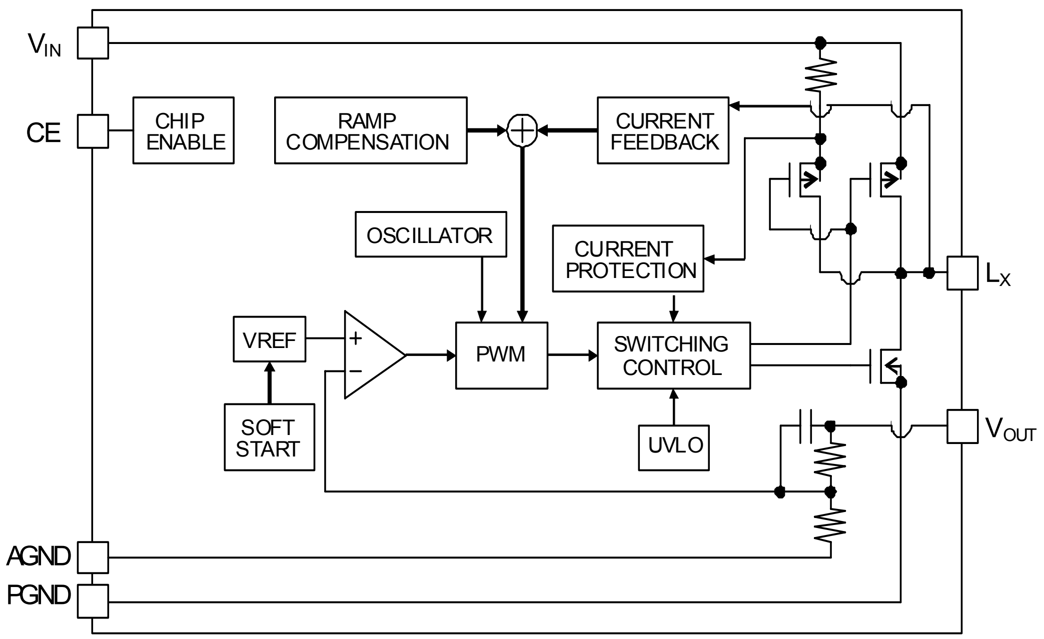
- Power source for battery-powered equipments.
- Power source for hand-held communication equipments, cameras, VCRs, camcorders.
- Power source for HDDs, portable equipments.

BLOCK DIAGRAMS

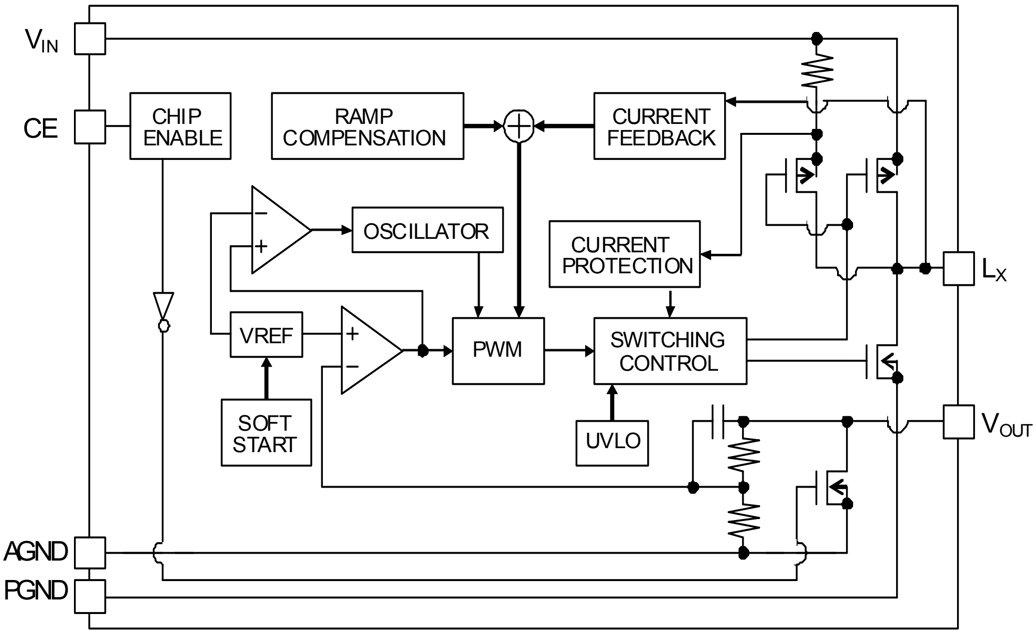
RP502xxx1B



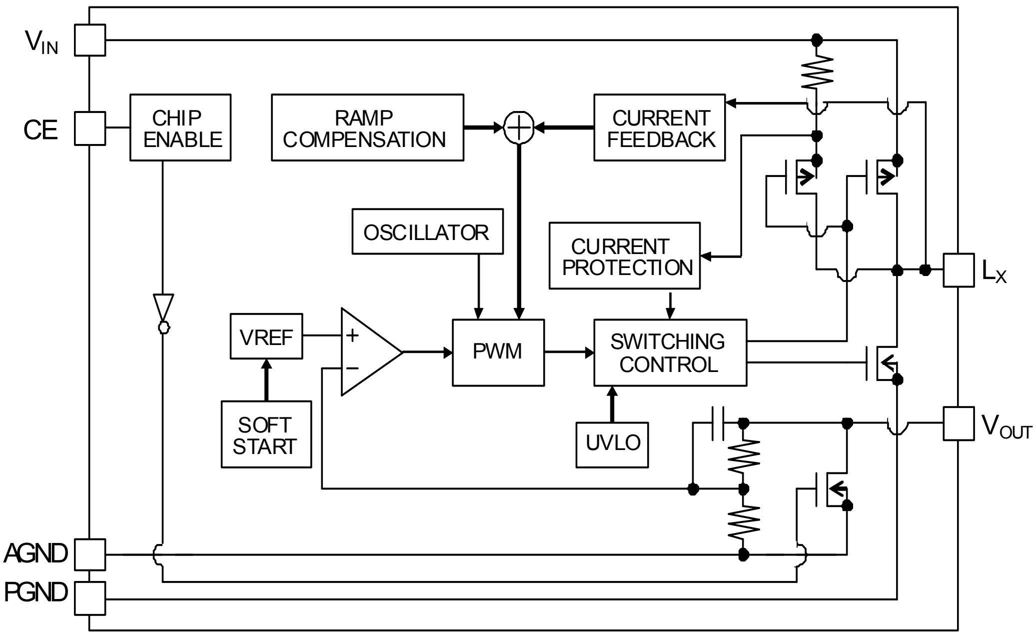
RP502xxx2B



RP502xxx3B



RP502xxx4B



SELECTION GUIDE

In the RP502 Series, output voltage, switching mode, and auto discharge function for the ICs are selectable at the user's request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RP502Zxx∗B-E2-F	WLCSP-6-P2	5,000 pcs	Yes	Yes
RP502Lxx∗B-TR	DFN1616-6	5,000 pcs	Yes	Yes

xx: The output voltage can be designated in the range of 0.8V(08) to 3.3V(33) in 0.1V steps[∗1].
(For other voltages, please refer to MARK INFORMATIONS.)

∗ : The switching mode and auto discharge function can be designated as shown below.

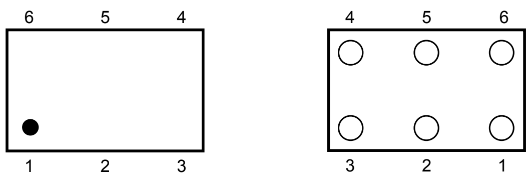
Code	PWM/VFM auto switching	Auto discharge function
1	Yes	No
2	No	No
3	Yes	Yes
4	No	Yes

Auto-discharge function quickly lowers the output voltage to 0V, when the chip enable signal is switched from the active mode to the standby mode, by releasing the electrical charge accumulated in the external capacitor.
∗1) 0.05V step is also available as a custom code.

PIN CONFIGURATIONS

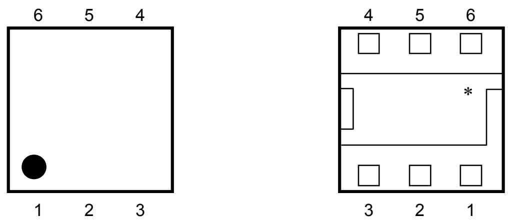
• WLCSP-6-P2

Mark Side **Bump Side**



• DFN1616-6

Top View **Bottom View**



PIN DESCRIPTIONS

• WLCSP-6-P2

Pin No	Symbol	Pin Description
1	V_{OUT}	Output Pin
2	PGND	Ground Pin
3	L_X	L_X Switching Pin
4	V_{IN}	Input Pin
5	AGND	Ground Pin
6	CE	Chip Enable Pin ("H" Active)

• DFN1616-6

Pin No	Symbol	Pin Description
1	CE	Chip Enable Pin ("H" Active)
2	AGND	Ground Pin
3	V_{IN}	Input Pin
4	L_X	L_X Switching Pin
5	PGND	Ground Pin
6	V_{OUT}	Output Pin

*) Tab is GND level. (They are connected to the reverse side of this IC.)
The tab is better to be connected to the GND, but leaving it open is also acceptable.

ABSOLUTE MAXIMUM RATINGS

AGND=PGND=0V

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	-0.3 to 6.0	V
V_{LX}	L_X pin Voltage	-0.3 to V_{IN} + 0.3	V
V_{CE}	CE Pin Input Voltage	-0.3 to 6.0	V
V_{OUT}	Output Voltage	-0.3 to 6.0	V
I_{LX}	L_X Pin Output Current	900	mA
P_D	Power Dissipation (WLCSP-6-P2) *	650	mW
	Power Dissipation (DFN1616-6) *	640	
Ta	Operating Temperature Range	-40 to 85	°C
Tstg	Storage Temperature Range	-55 to 125	°C

*) For Power Dissipation, please refer to PACKAGE INFORMATION.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the lifetime and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

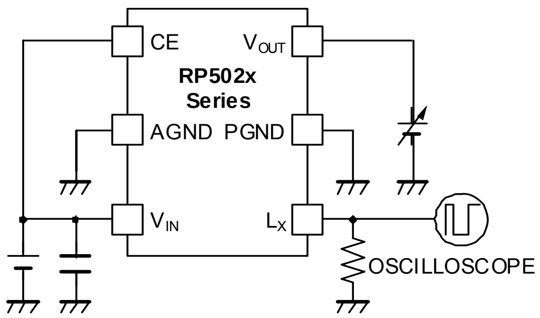
- **RP502xxxxB**

(Ta=25°C)

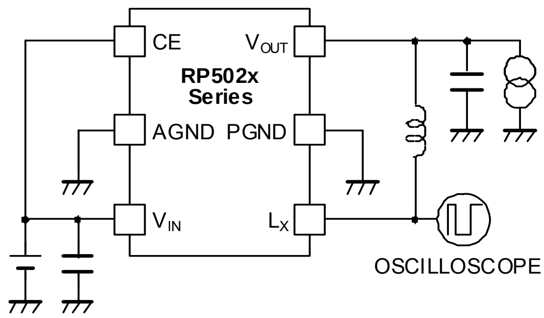
Symbol	Item	Conditions		MIN.	TYP.	MAX.	Unit
V_{IN}	Operating Input Voltage	V_{OUT} ≥1.0		2.5		5.5	V
		V_{OUT} <1.0		2.5		4.5	
V_{OUT}	Output Voltage	V_{IN} = V_{CE} =3.6V or V_{SET} +1V	V_{OUT} ≥1.6	-1.5%		+1.5%	V
			V_{OUT} <1.6	-0.024		+0.024	
$\Delta V_{OUT}/\Delta Ta$	Output Voltage Temperature Coefficient	-40°C ≦Ta ≦85°C			±100		ppm/°C
fosc	Oscillator Frequency	V_{IN} = V_{CE} =3.6V or V_{SET} +1V		2.64	3.3	3.96	MHz
I_{DD1}	Supply Current 1	V_{IN} = V_{CE} =5.5V, V_{OUT} =0V			750	900	μA
I_{DD2}	Supply Current 2	V_{IN} = V_{CE} = V_{OUT} =5.5V	PWM/VFM		180	240	μA
			PWM fixed		750	900	
Istandby	Standby Current	V_{IN} = 5.5V, V_{CE} = 0V			0	5	μA
I_{CEH}	CE "H" Input Current	V_{IN} = V_{CE} = 5.5V		-1	0	1	μA
I_{CEL}	CE "L" Input Current	V_{IN} = 5.5V, V_{CE} = 0V		-1	0	1	μA
I_{VOUTH}	V_{OUT} "H" Input Current*1	V_{IN} = V_{OUT} = 5.5V, V_{CE} = 0V		-1	0	1	μA
I_{VOUTL}	V_{OUT} "L" Input Current	V_{IN} = 5.5V, V_{CE} = V_{OUT} = 0V		-1	0	1	μA
R_{LOW}	Low Output Nch Tr. ON Resistance*2	V_{IN} = 3.6V, V_{CE} =0V			40		Ω
$I_{LXLEAKH}$	L_X Leakage Current "H"	V_{IN} = V_{LX} = 5.5V, V_{CE} = 0V		-1	0	1	μA
$I_{LXLEAKL}$	L_X Leakage Current "L"	V_{IN} = 5.5V, V_{CE} = V_{LX} = 0V		-5	0	5	μA
V_{CEH}	CE Input Voltage "H"	V_{IN} = 5.5V		1.0			V
V_{CEL}	CE Input Voltage "L"	V_{IN} = 2.5V				0.4	V
R_{ONP}	ON Resistance of Pch Tr.	V_{IN} = 3.6V, I_{LX} = -100mA			0.5		Ω
R_{ONN}	ON Resistance of Nch Tr.	V_{IN} = 3.6V, I_{LX} = -100mA			0.5		Ω
Maxduty	Maximum Duty			100			%
t_{START}	Soft-start Time	V_{IN} = V_{CE} =3.6V or V_{SET} +1V			120	150	μs
I_{LXLIM}	L_X Current Limit	V_{IN} = V_{CE} =3.6V or V_{SET} +1V	V_{OUT} ≥1.2	600	900		mA
			V_{OUT} <1.2	500	800		
t_{PROT}	Protection Delay Time	V_{IN} = V_{CE} =3.6V or V_{SET} +1V		0.5	1.5	5	ms
V_{UVLO1}	UVLO Detector Threshold	V_{IN} = V_{CE}		2.1	2.2	2.3	V
V_{UVLO2}	UVLO Released Voltage	V_{IN} = V_{CE}		2.2	2.3	2.4	V

Test circuit is "OPEN LOOP" and AGND=PGND=0V unless otherwise noted.
∗1) without auto discharge function
∗2) with auto discharge function

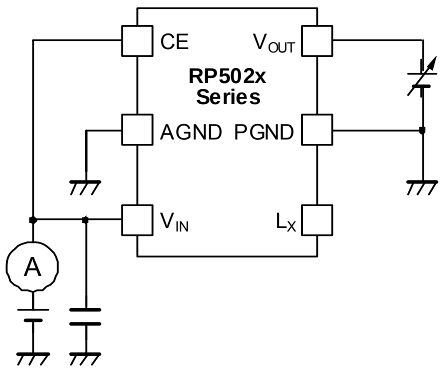
TEST CIRCUITS



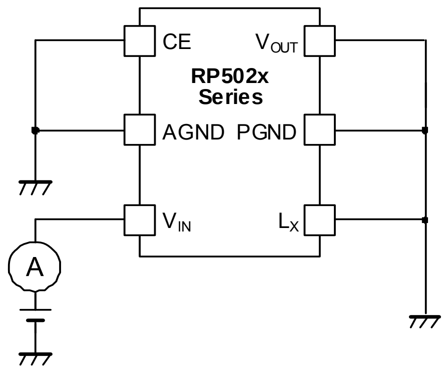
Output Voltage



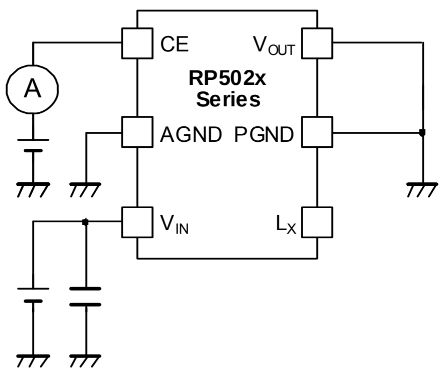
Oscillator Frequency



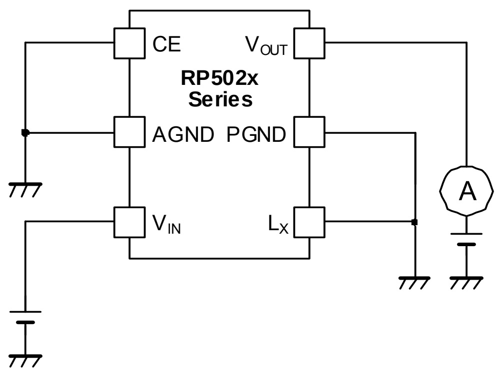
Supply Current 1,2



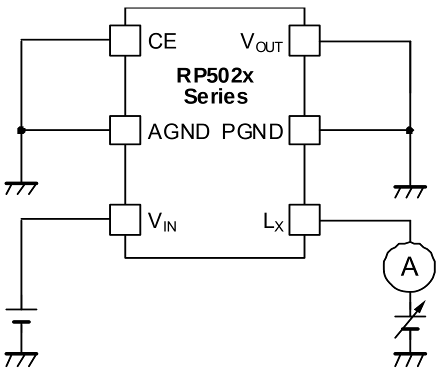
Standby Current



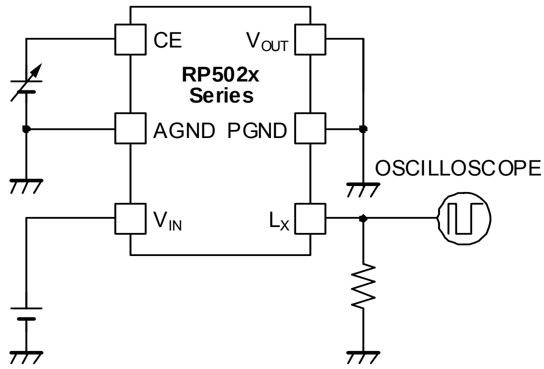
CE "H"/"L" Input Current



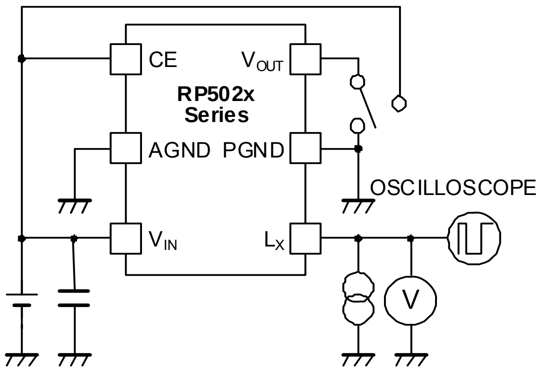
V_{OUT} "H"/"L" Current



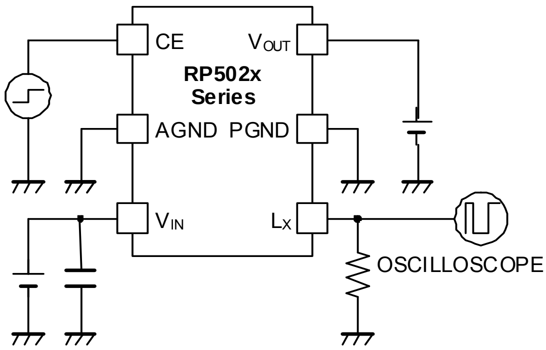
L_X Leakage Current



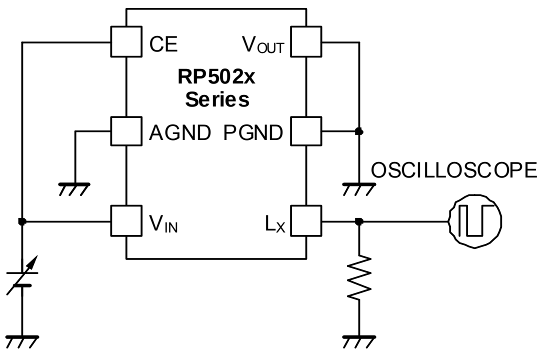
CE Input Voltage



Pch • Nch Tr. ON resistance /
Output Delay for Protection / L_X Current limit

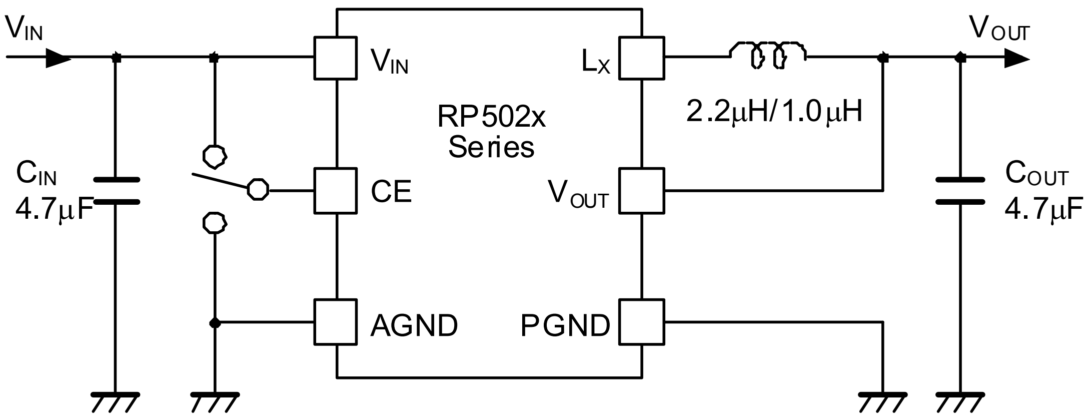


Soft-start Time



UVLO Detector Threshold • Released Voltage

TYPICAL APPLICATION



Symbol	Parts Recommendation
C_{IN}	4.7µF Ceramic JMK107BJ475MA (TAIYO YUDEN)
C_{OUT}	4.7µF Ceramic JMK107BJ475MA (TAIYO YUDEN)
L	2.2µH NR 3010T 2R2M (TAIYO YUDEN) ,1.0µH MIPS 2520 D1R0 (FDK)

TECHNICAL NOTES

When using the R502x Series, consider the following points:

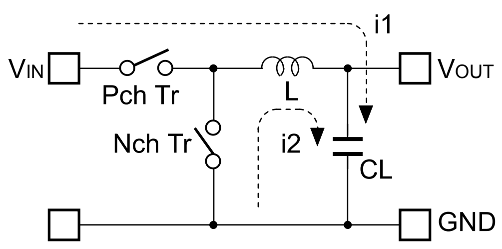
- Set AGND in the same level as PGND.
- Set external components such as an inductor, C_{IN}, and C_{OUT} as close as possible to the ICs. V_{IN}, C_{IN} and PGND have to be wired as close as possible. If the impedances of V_{IN} line and PGND line are high, the switching current will fluctuate the electric potential of the inside the ICs. As a result, the operation may become unstable. The impedances of power supply line and PGND line must be as low as possible. Please note that a large current caused by the switching current flows into V_{IN}, PGND, Inductor, L_X, and V_{OUT}. Separate the wiring between V_{OUT} pin and inductor from the wiring of load.
- For C_{IN}, use a ceramic capacitor with a low ESR. The recommended condenser capacity for C_{IN} is 4.7μF or more. Also, the recommended condenser capacity for C_{OUT} is 4.7μF.
- Choose an inductor from the range of 1.0 to 2.2μH. The internal phase compensation has been determined based on the above-mentioned inductor value and the C_{OUT} value. For stable operation, these conditions are necessary. Choose an inductor that is low DC resistance, has enough permissive current, and is strong against magnetic saturation. Decide the inductance value with consideration of the load current under the condition of use. If the inductance value is low, the peak value of L_X current may increase along with the increase of the load current. As a result, the peak value of L_X may reach to the “L_X Limit Current” and may trigger the overcurrent protection circuit.
- Please note that overcurrent protection circuit may be affected by self-heating and heat radiation environment.

∗ The performance of power source circuits using these ICs largely depends upon the peripheral circuits.
Pay attention to the setting of the peripheral components. In particular, when designing the peripheral circuit, the constant values (voltage, current and power) for each part, PCB pattern and the ICs should not be exceeded.

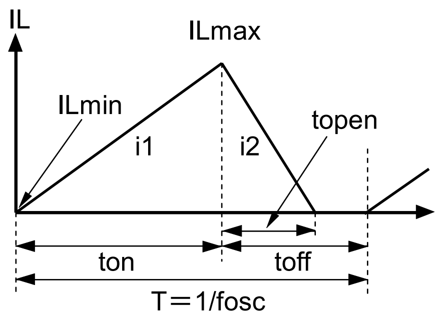
Operation of step-down DC/DC converter and Output Current

The step-down DC/DC converter charges energy in the inductor when the Lx transistor is turned on, and discharges the energy when the Lx transistor is turned off. The step-down DC/DC converter also controls with the less energy loss and supplies the lower output voltage than the input voltage. The operation of the DC/DC converter will be explained with the following diagrams:

<Basic Circuit>



<Inductor Current >



・Step 1: Pch Tr. turns on and current IL (=i1) flows. Then, L and CL are charged with energy. At this moment, IL (=i1) increases from ILmin (=0) to ILmax in proportion to the On-time period (ton) of Pch Tr.

・Step 2: When Pch Tr. turns off, Synchronous rectifier Nch Tr. turns on and IL(=i2) flows in order to maintain IL at ILmax.

・Step 3: IL (=i2) starts to decrease gradually when topen time period starts. IL reaches to ILmin (IL=ILmin=0) when topen time period ends and then Nch Tr. turns off. In the continuous mode, toff time period runs out before IL becomes ILmin (IL=ILmin=0). The next cycle starts. Pch Tr. turns on and Nch Tr, turns off. Since toff time period runs out before IL becomes ILmin (IL=ILmin=0), ILmin (>0) is still remaining. In this case, IL starts increasing from ILmin (>0).

In the case of PWM control system, the output voltage is maintained constant by keeping the switching time (fosc) per unit constant, and by controlling the On-time period (ton).

When the step-down operation is constant and stable, as shown in the above "Inductor Current", the maximum inductor current (ILmax) will be same as the on-time period of Pch Tr. (ton) and the minimum inductor current (ILmin) will be same as the on-time period of Pch Tr. (toff).
The difference between ILmax and ILmin is described as ΔI:

$\Delta I = ILmax - ILmin = V_{OUT} \times topen / L = (V_{IN} - V_{OUT}) \times ton / L$ ....Equation 1

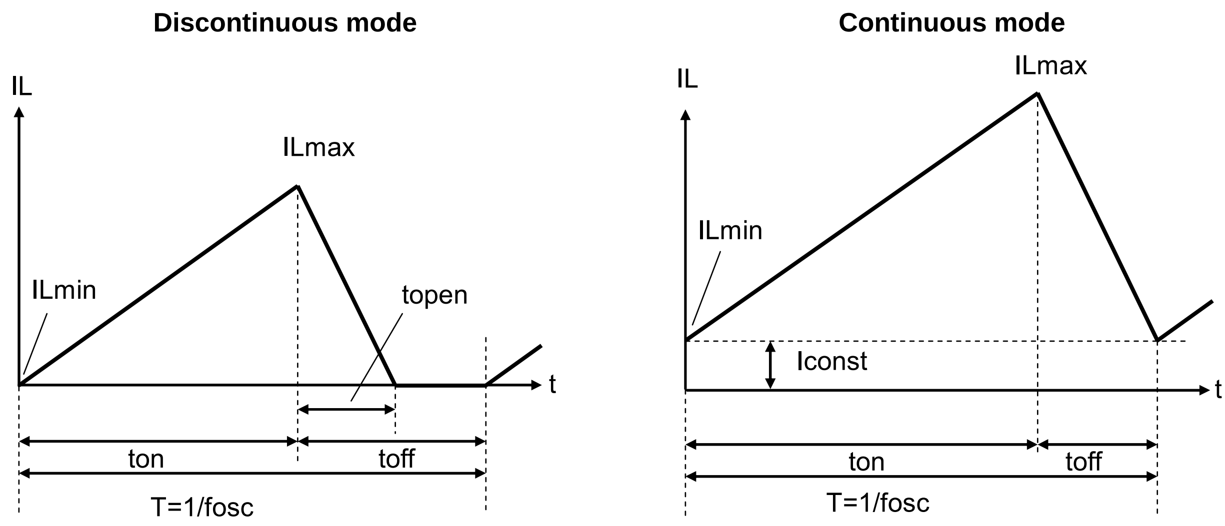
Wherein,

T = 1 / fosc = ton + toff
duty (%)= ton / T x 100 = ton x fosc x 100
topen ≦ toff

In Equation 1, "V_{OUT} x topen / L" shows the amount of current change at the on-time. "(V_{IN} – V_{OUT}) x ton / L" shows the amount of current change at the off-time".

Discontinuous mode and Continuous mode

As the following diagram shows, when the output current (I_{OUT}) is relatively small, topen will be smaller than toff (topen < toff). In this case, the all energy charged in the inductor during the time period of ton will be discharged during the time period of toff. As a result, IL will be ILmin (=0). If I_{OUT} is gradually increased, eventually topen will be equal to toff (topen=toff). If I_{OUT} is further increased, ILmin will be larger than zero (ILmin>0). The former mode (topen<toff) is referred to as “discontinuous mode” and the latter mode (topen=toff) is referred to as “continuous mode”.



In the continuous mode, solve the equation 1 for ton, and assume that the solution is tonc.

tonc = T x V_{OUT} / V_{IN} .... Equation 2

If ton is smaller than tonc (ton<tonc), it is discontinuous mode. If ton is equal to tonc (ton=tonc), it is continuous mode.

Output Current and selection of External components

The relation between the output current and external components is as follows:

When Pch Tr. of L_X is turned on:

(Ripple Current p-p value is described as I_{RP}, On Resistances of Pch Tr. and Nch Tr. are respectively described as R_{ONP} and R_{ONN}. Also, the DC resistor of the inductor is described as R_L.)

The time period of L_X Pch Tr. being "ON" is described as ton.

$V_{IN} = V_{OUT} + (R_{ONP} + R_L) \times I_{OUT} + L \times I_{RP} / ton$ ....Equation 3

The time period of Lx Pch Tr. being "OFF" is described as toff. (Nch Tr. is "ON"):

$L \times IRP / toff = R_{ONN} \times I_{OUT} + V_{OUT} + R_L \times I_{OUT}$ ....Equation 4

Substitute Equation 4 into Equation 3 to solve for ON duty of Pch Tr.: (D_{ON} = ton / (toff + ton).

$D_{ON} = (V_{OUT} + R_{ONN} \times I_{OUT} + R_L \times I_{OUT}) / (V_{IN} + R_{ONN} \times I_{OUT} - R_{ONP} \times I_{OUT})$ ....Equation 5

Ripple Current is solved by the following equation:

$I_{RP} = (V_{IN} - V_{OUT} - R_{ONP} \times I_{OUT} - R_L \times I_{OUT}) \times D_{ON} / fosc / L$ ....Equation 6

Wherein, peak current that flows through L and L_X Tr. is solved by the following equation:

$ILxmax = I_{OUT} + I_{RP} / 2$ ....Equation 7

It is necessary to consider ILxmax when deciding the input/output conditions and selecting the peripheral components.

∗The above calculation is based on the ideal operation of the ICs in continuous mode.

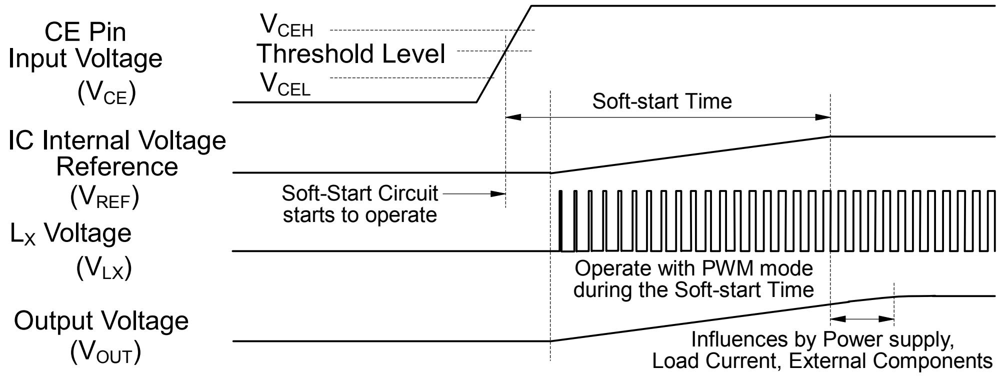
TIMING CHART

(1) Soft-Start Time

● In the case of starting the ICs with CE

The ICs start to operate when the CE pin voltage (V_{CE}) exceeds the threshold voltage. The threshold voltage is set between CE “H” input voltage (V_{CEH}) and CE ”L” input voltage (V_{CEL}).

When the ICs start to operate, the soft-start circuit also starts to operate. After a certain period of time, the reference voltage (V_{REF}) of the inside the ICs gradually rise up to the specified value.



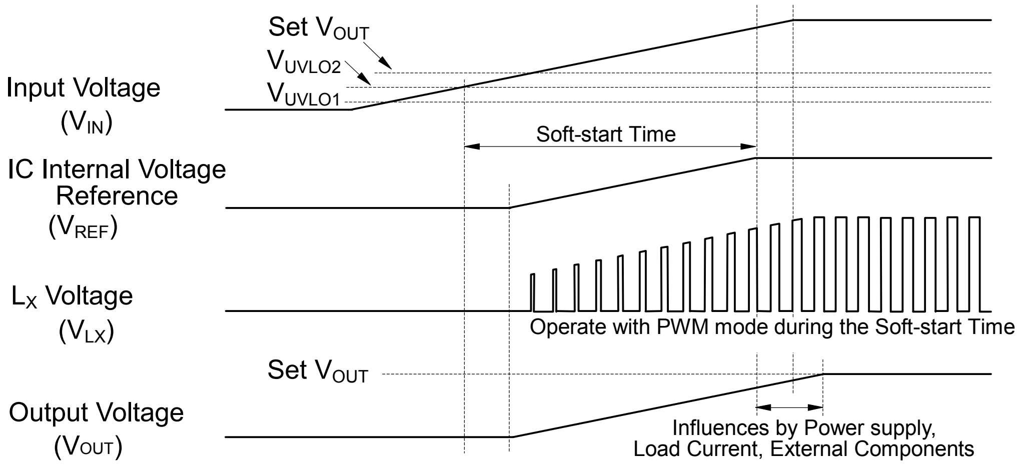
Soft-start time is the time period from when the soft-start circuit started to when the reference voltage reached to the specified value.

∗ Soft-start time may not always equal to the actual start-up time of DC/DC converter.
Start-up peed could be affected by the power supply capacity, the output current value, the inductor value and capacitor value.

● In the case of starting with power supply

After starting up with power supply, the ICs starts to operate when the input voltage (V_{IN}) exceeds the UVLO released voltage (V_{UVL02}). The soft-start circuit starts to operate and then the reference voltage (V_{REF}) of the inside the ICs gradually rise up to the specified value.

Soft-start time is the time period from when the soft-start circuit started to when the reference voltage reached to the specified value.



∗The start-up speed of the output voltage could be affected by the following elements.

(a) The start-up speed of the input voltage (V_{IN}), which is determined by the power supply for the ICs and also by the input capacitor (C_{IN}).

(b) The output capacitor (C_{OUT}) value and the output current value.

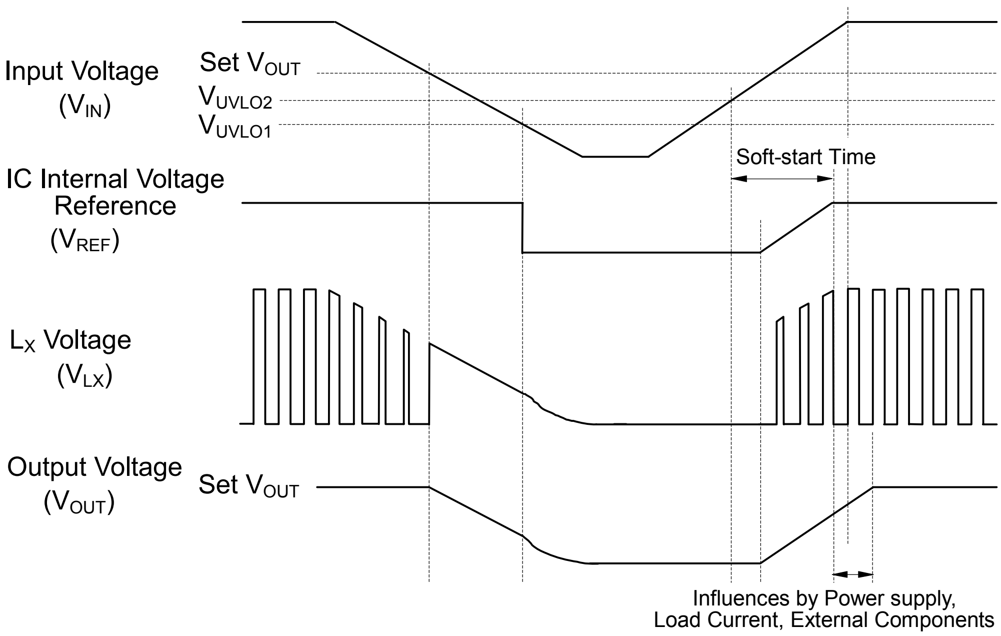
(2) Under Voltage Lockout (UVLO) Circuit

The step-down DC/DC converter stops and ON duty becomes 100%, if input voltage (V_{IN}) becomes less than the set output voltage (Set V_{OUT}), the output voltage (V_{OUT}) gradually drops according to the input voltage (V_{IN}).

If the input voltage drops more and becomes less than UVLO detector threshold (V_{UVLO1}), the under voltage lockout circuit (UVLO) operates, the IC internal reference voltage (V_{REF}) stops, switching transistors turn off and the output voltage drops according to the load and output capacitor C_{OUT} value.

To restart the normal operation, the input voltage (V_{IN}) must be more than the UVLO released voltage (V_{UVLO2}).

The timing chart below describes the operation with varying the input voltage (V_{IN}).



* The start-up speeds of V_{OUT} at operation and recovery or the default voltage and the output current of C_{OUT}. Could affect on the waveform in the above chart. Therefore, the actual waveform could be slightly different from the waveform in the above chart.

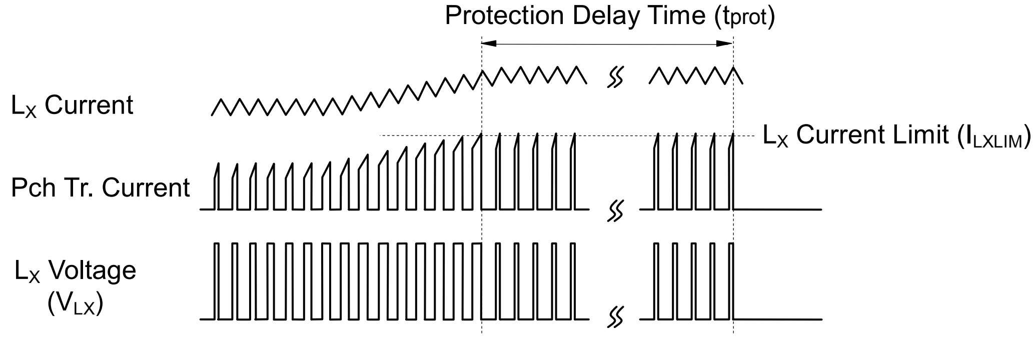
RICOH

(3) Overcurrent Protection Circuit, Latch Type Protection Circuit

Overcurrent protection circuit supervises the peak current of the inductor (The current passing through Pch Tr.) at each switching cycle. If the peak current exceeds the L_X current limit (I_{LXLIM}), the overcurrent protection circuit turns off the Pch transistor. The L_X current limit of the RP502x Series is set at Typ. 900mA (V_{OUT}≥1.2V), and Typ. 800mA (V_{OUT}<1.2V).

Latch type protection circuit latches the built-in driver in OFF state to stop the operation of the ICs if the overcurrent status continues more than the protection delay time (tprot).

∗L_X limit current (I_{LXLIM}) and the protection delay time (tprot) could be easily affected by self-heating and ambient environment. The drastic drop of input voltage (V_{IN}) or the unstable input voltage caused by the short-circuiting in the output (V_{OUT}) may affect on the protection operation and the delay time.

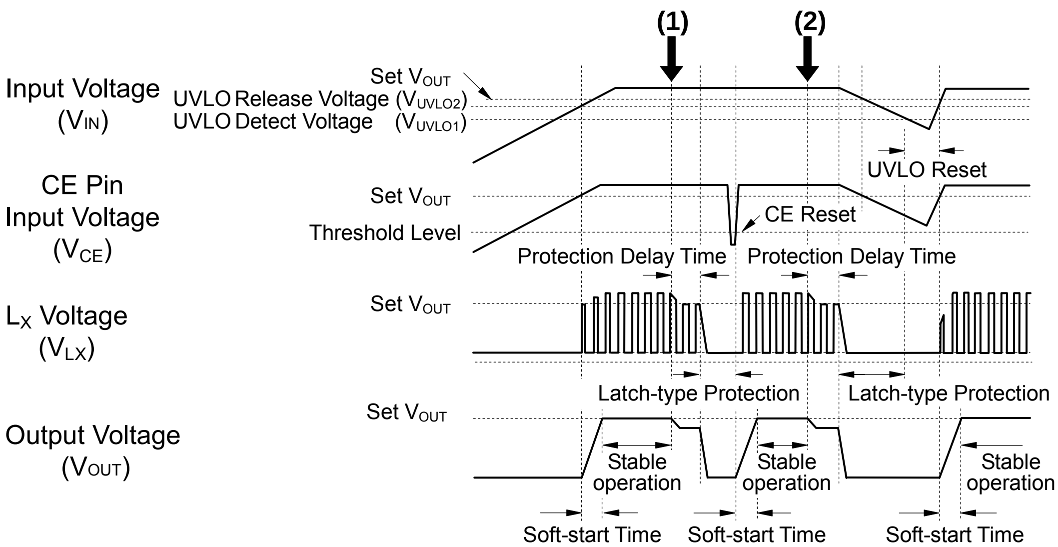


To release the latch type protection circuit, reset the ICs by inputting "L" into CE pin or make the input voltage lower than the UVLO detector threshold (V_{UVL01}).

As the following timing chart shows, the changing process of input voltage flows as follows: start-up, stable operation, high load condition, CE reset, stable operation, input voltage drop, input voltage recovery, and stable operation.

If the ICs enters the high load condition due to short-circuit or such, after the protection delay time (tprot), the built-in driver is latched in OFF state. V_{LX} becomes "L" and then the output voltage turns off. There are two ways of releasing the latch type protection: CE reset and UVLO reset.

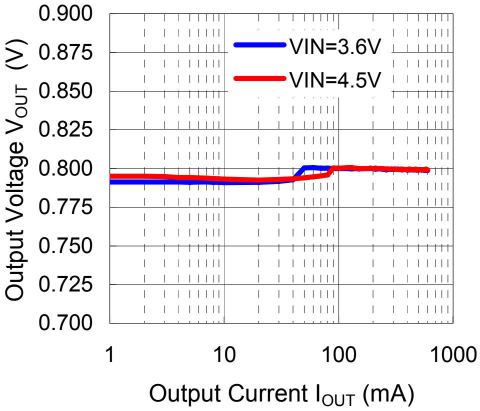
(1) CE reset makes the CE signal to "L" once and then turns the CE signal back to "H" again.
(2) UVLO rest makes the input voltage lower than the UVLO voltage (V_{UVL01}).



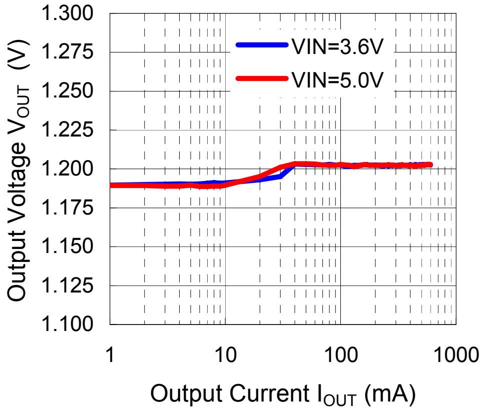
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

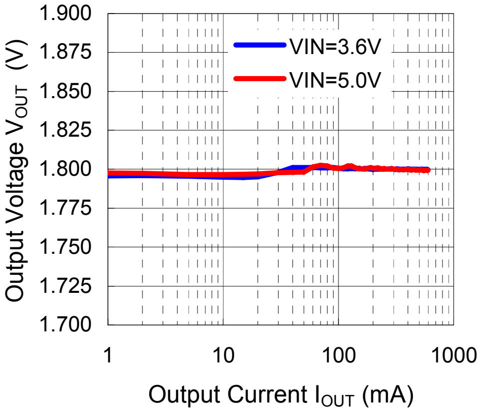
RP502x081B/083B



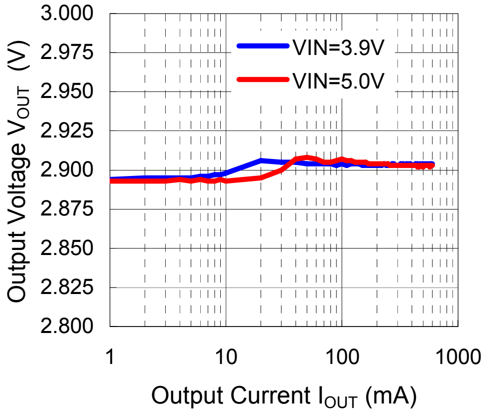
RP502x121B/123B



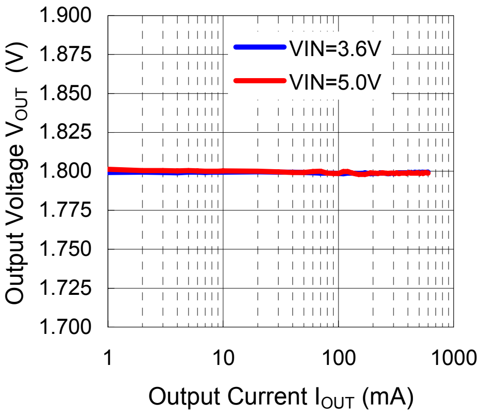
RP502x181B/183B



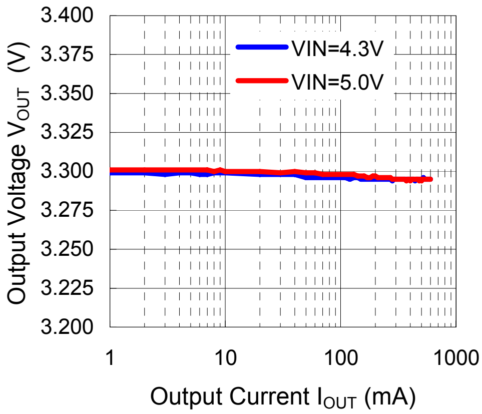
RP502x291B/293B



RP502x182B/184B



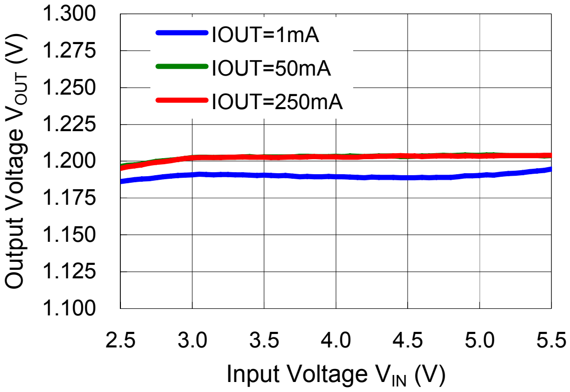
RP502x332B/334B



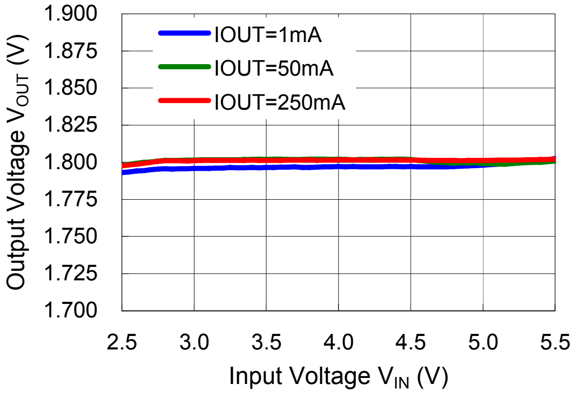
RICOH

2) Output Voltage vs. Input Voltage

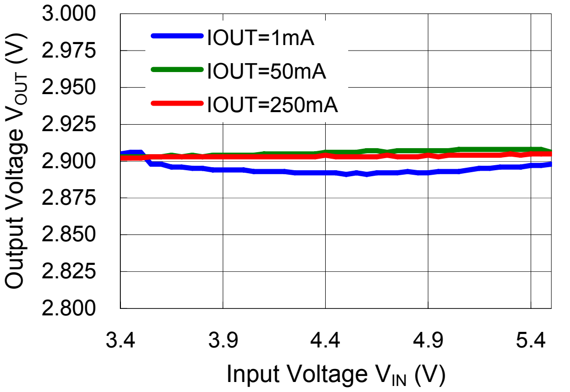
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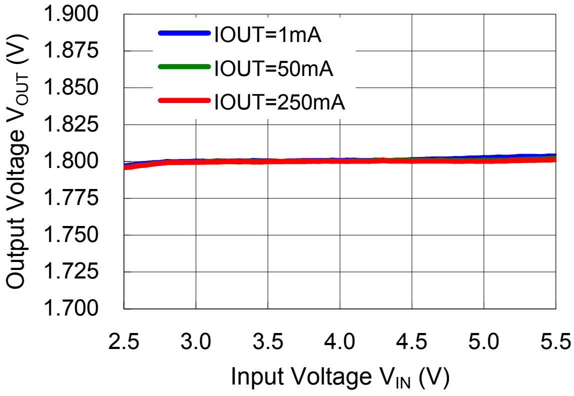
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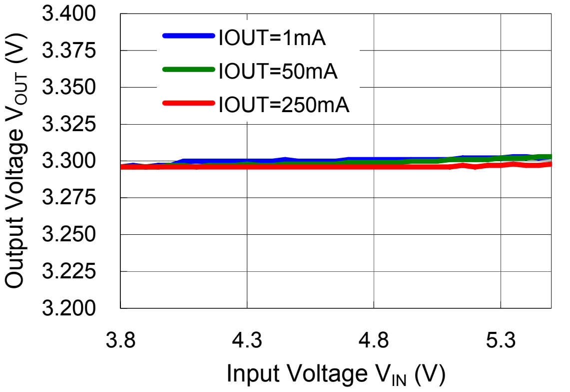
RP502x291B/293B



RP502x182B/184B

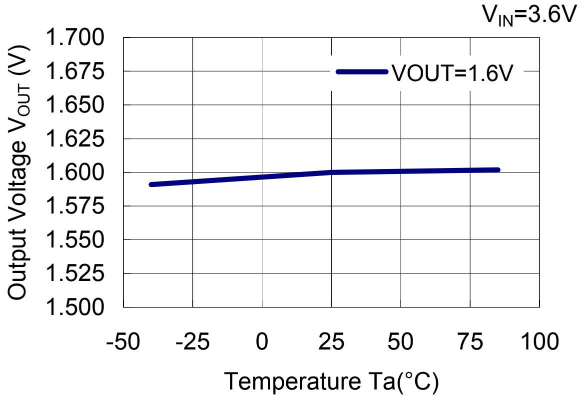


RP502x332B/334B



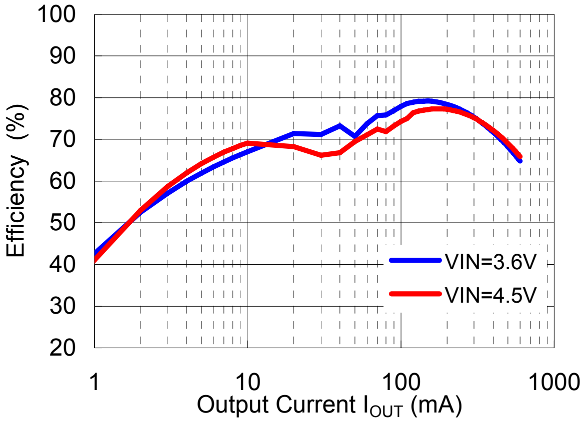
3) Output Voltage vs. Temperature

RP502x16xB

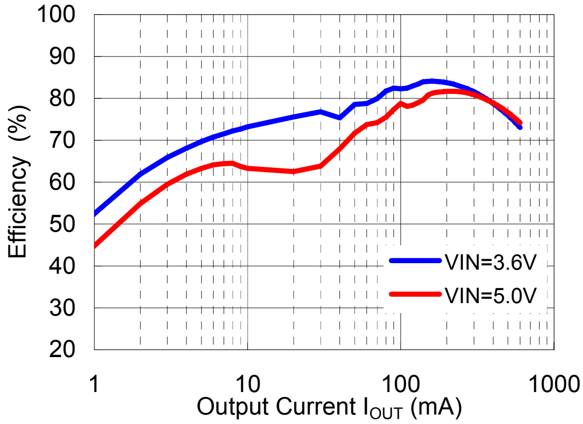


4) Efficiency vs. Output current

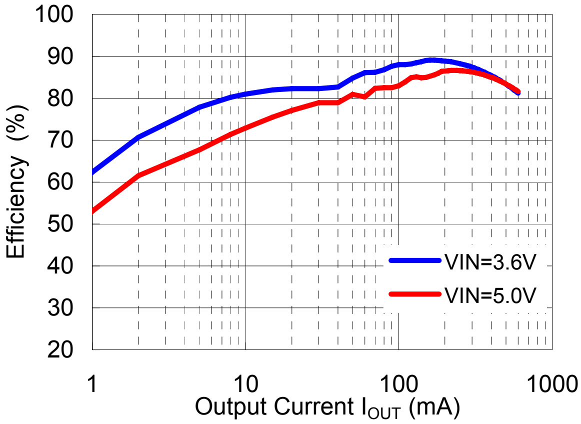
RP502x081B/083B



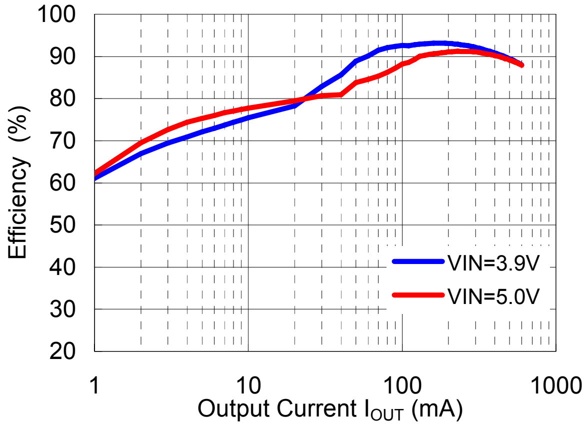
RP502x121B/123B



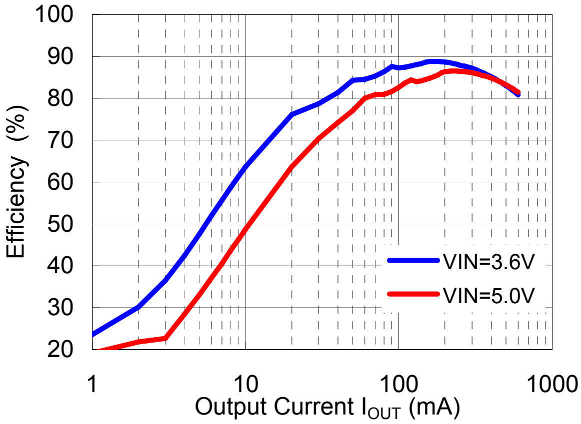
RP502x181B/183B



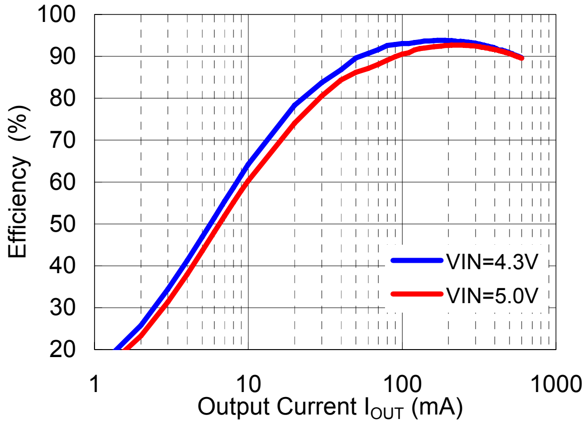
RP502x291B/293B



RP502x182B/184B

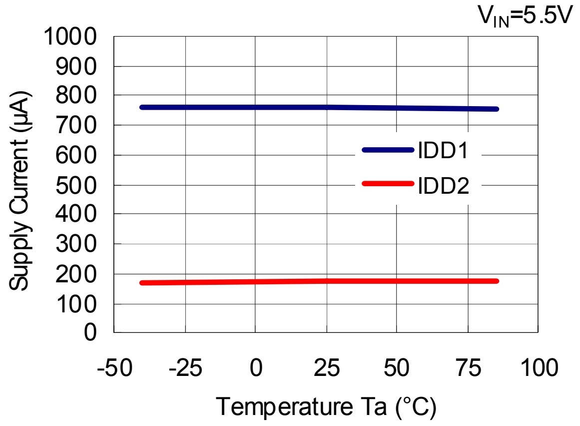


RP502x332B/334B



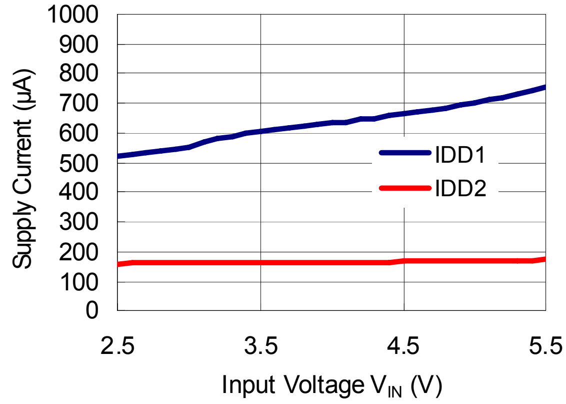
5) Supply Current 1, 2 vs.Temperature

RP502x15xB



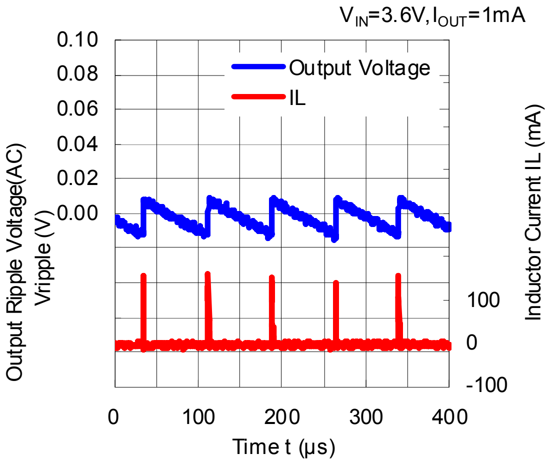
6) Supply Current 1, 2 vs. Input Voltage

RP502x15xB

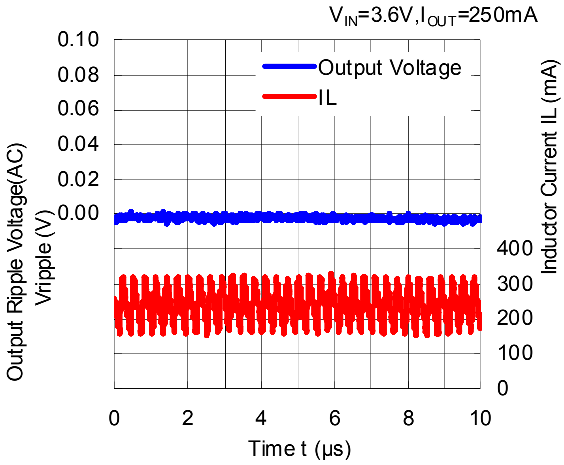


7) DC/DC Output Waveform

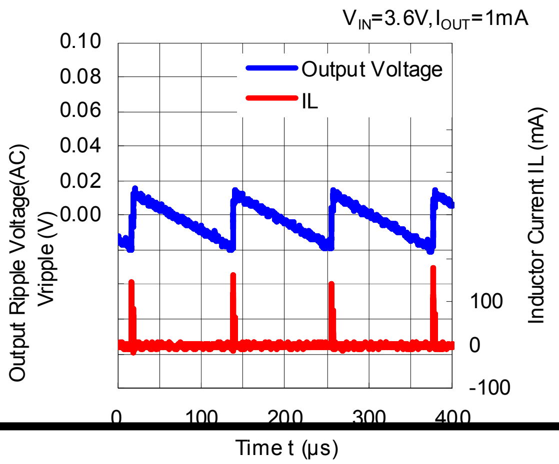
RP502x081B/083B



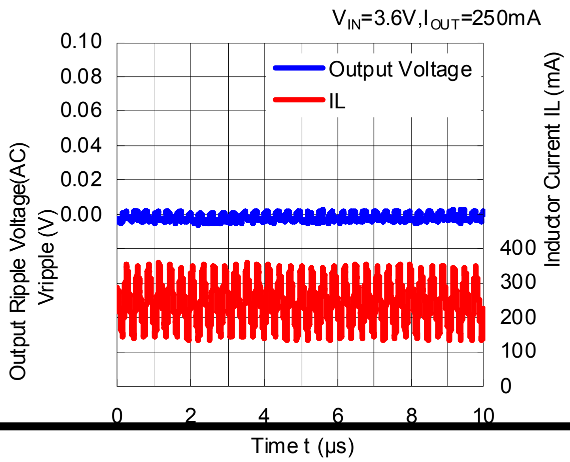
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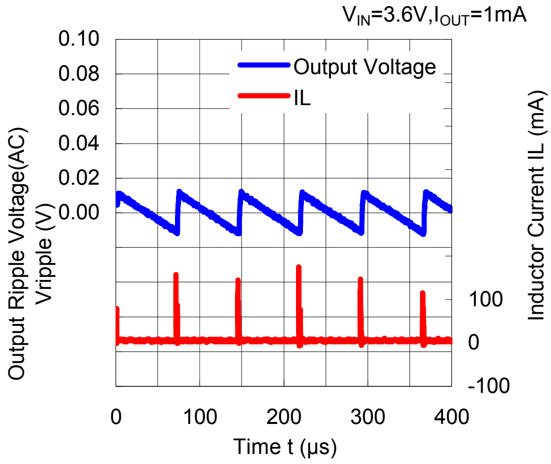
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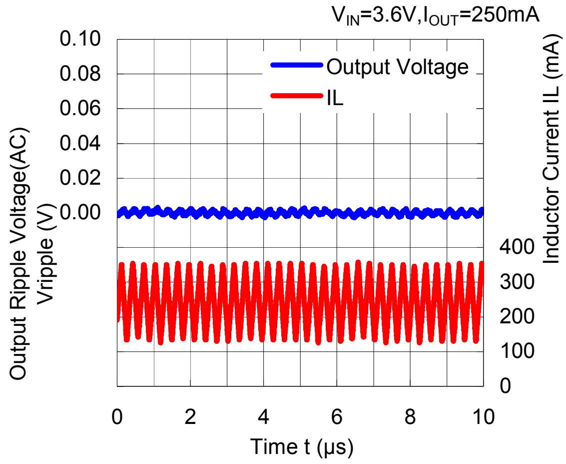
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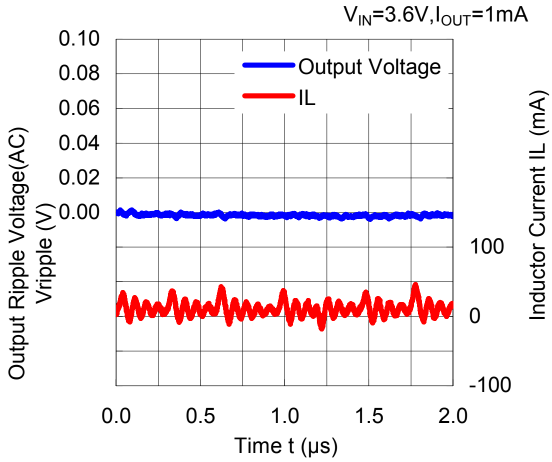
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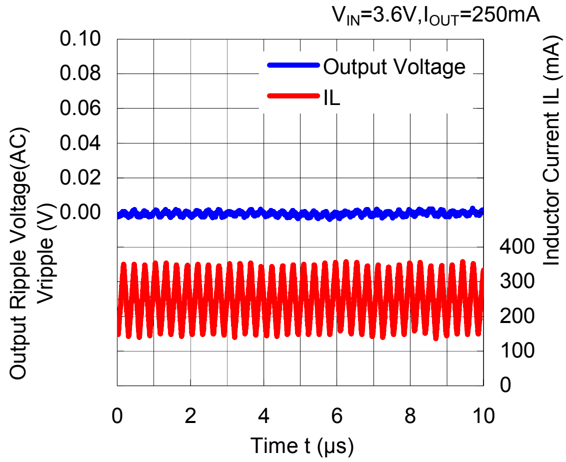
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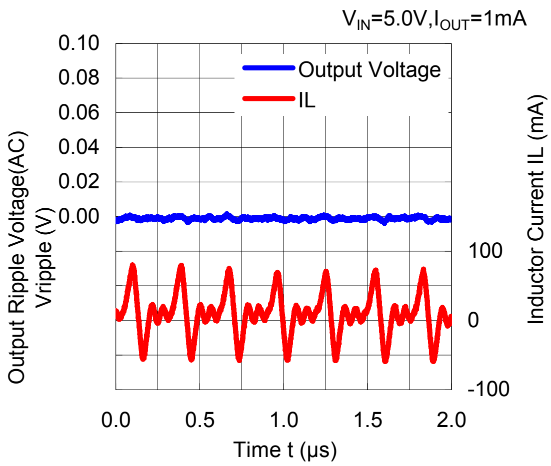
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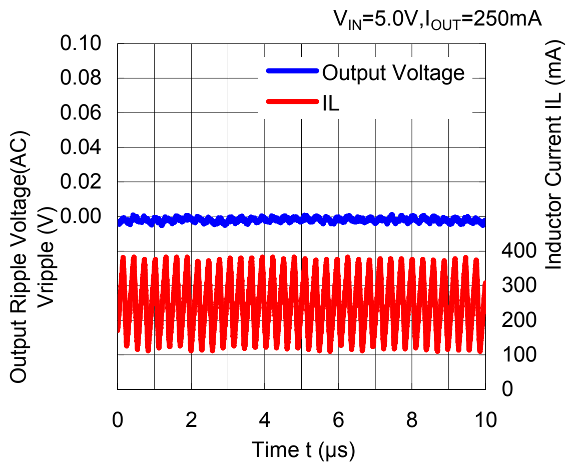
RP502x182B/184B



RP502x332B/334B



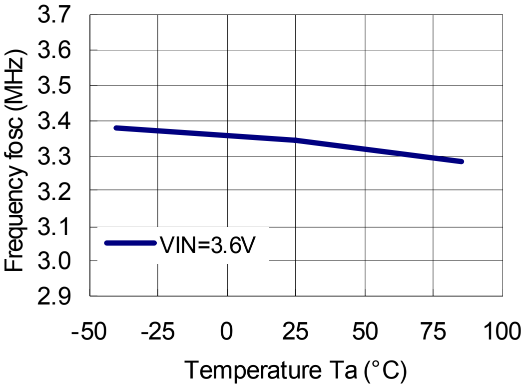
RP502x332B/334B



8) Oscillator Frequency vs. Temperature

RP502x12xB

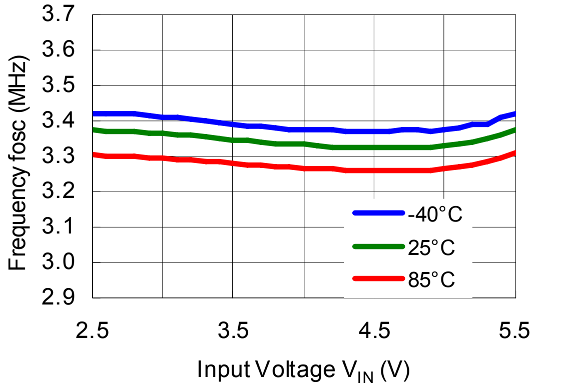
V_{IN}=3.6V,I_{OUT}=250mA



9) Oscillator Frequency vs. Input Voltage

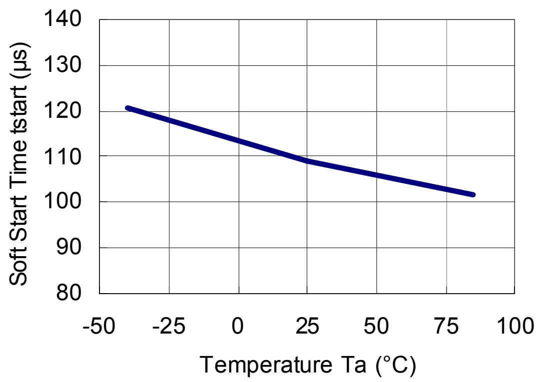
RP502x12xB

I_{OUT}=250mA



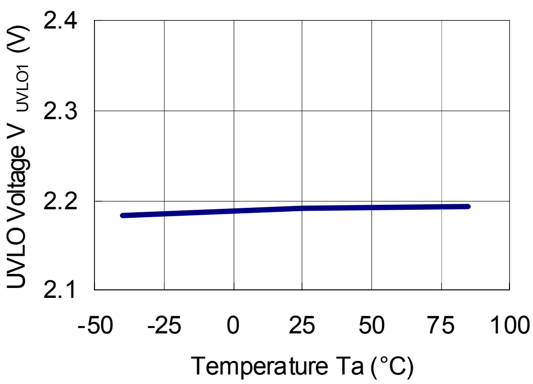
10) Soft-start Time vs. Temperature

RP502x15xB

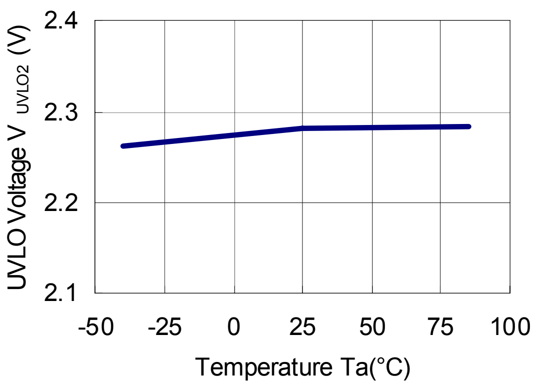


11) UVLO Detector Threshold / Released Voltage vs. Temperature

UVLO Detector Threshold
RP502x15xB

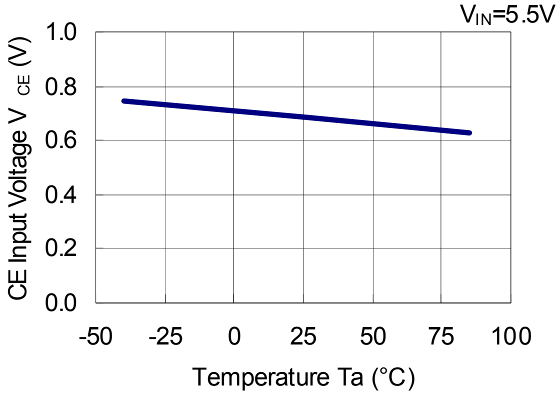


Released Voltage
RP502x15xB

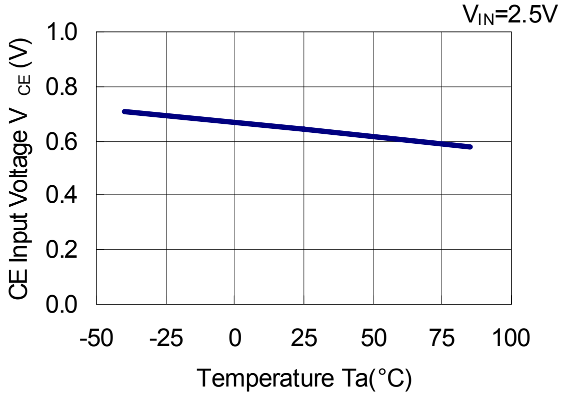


12) CE Input Voltage vs. Temperature

CE "H" Input Voltage
RP502x16xB

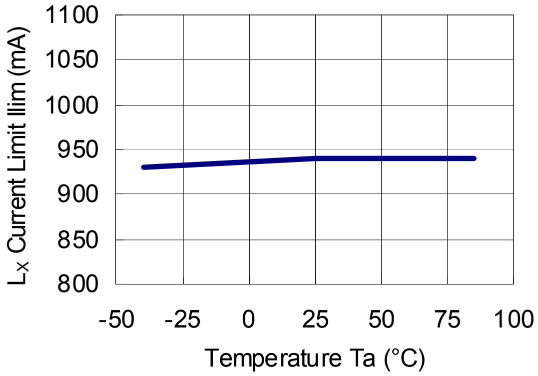


CE "L" Input Voltage
RP502x16xB

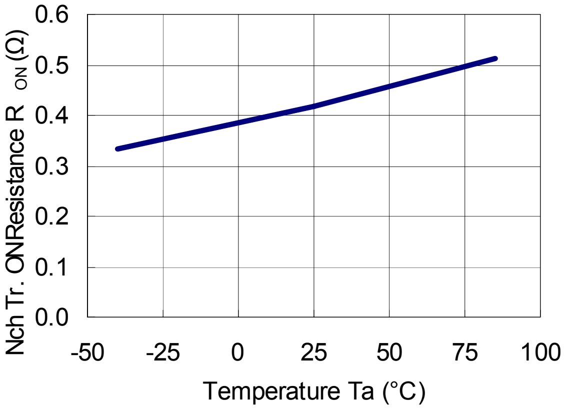


13) L_X Current Limit vs. Temperature

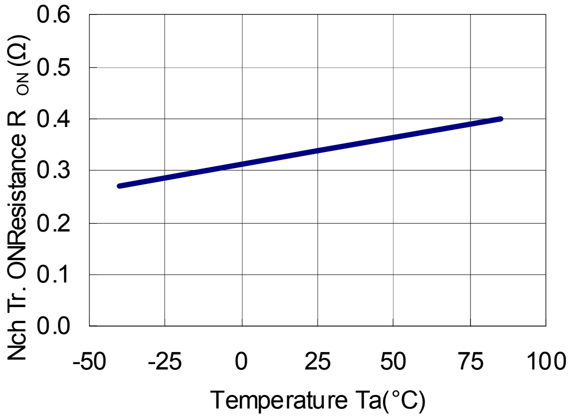
RP502x15xB



14) Nch Tr. ON Resistance vs. Temperature

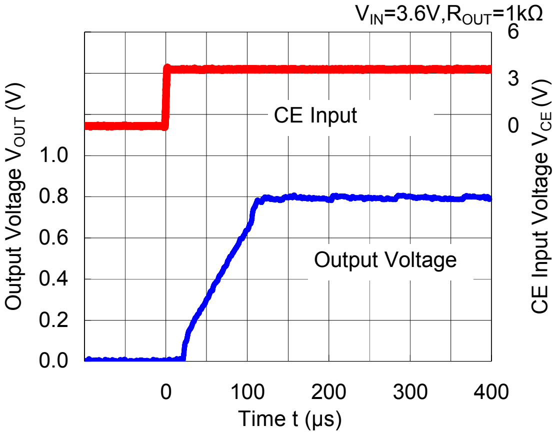


15) Pch Tr. ON Resistance vs.Temperature

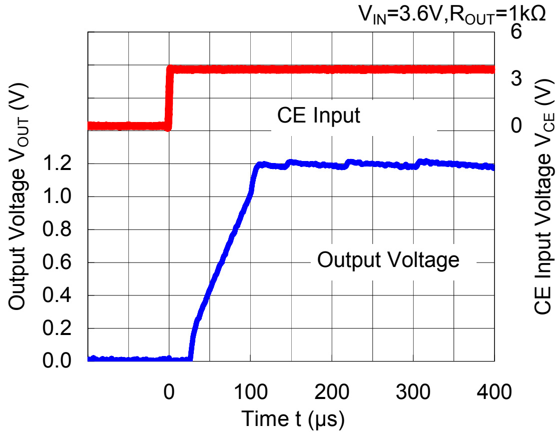


16) Turn on speed with CE pin

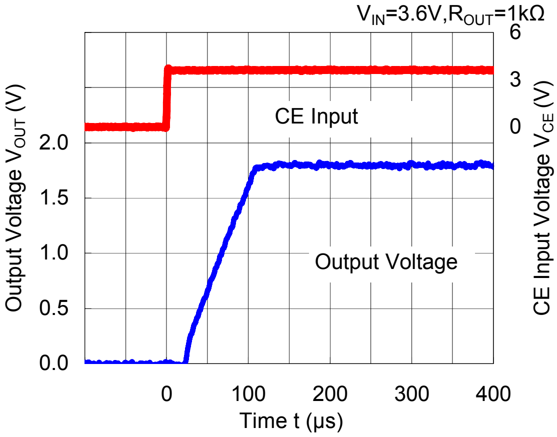
RP502x081B/083B



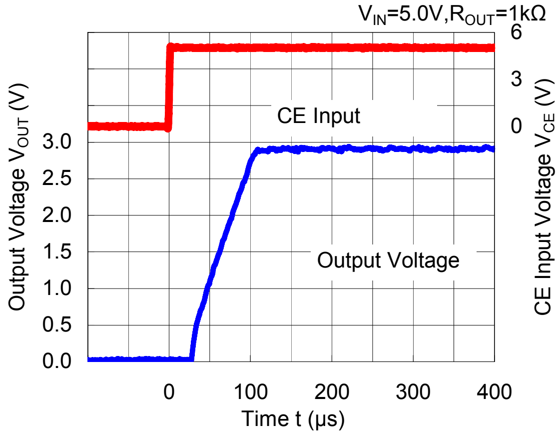
RP502x121B/123B



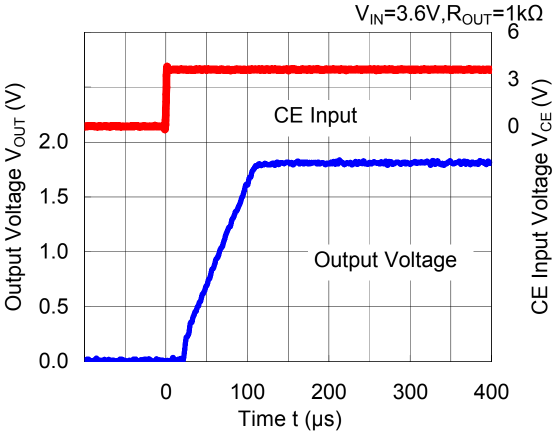
RP502x181B/183B



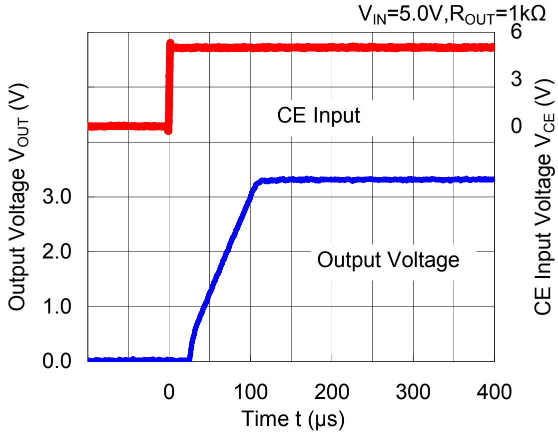
RP502x291B/293B



RP502x182B/184B

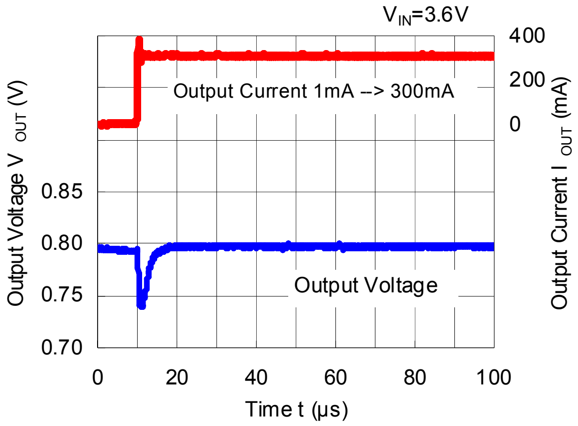


RP502x332B/334B

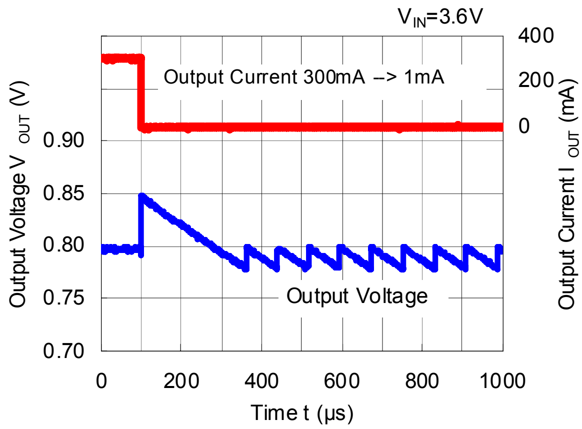


17) Load Transient Response

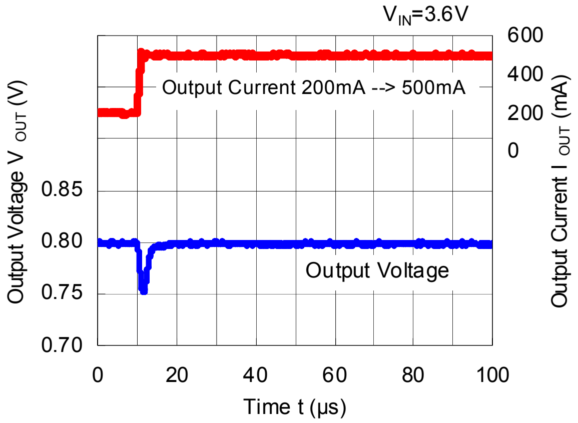
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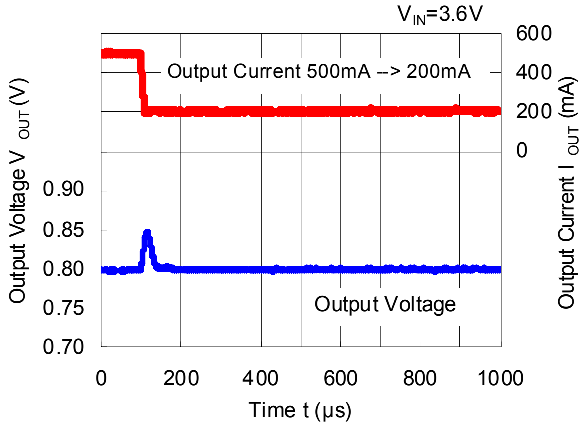
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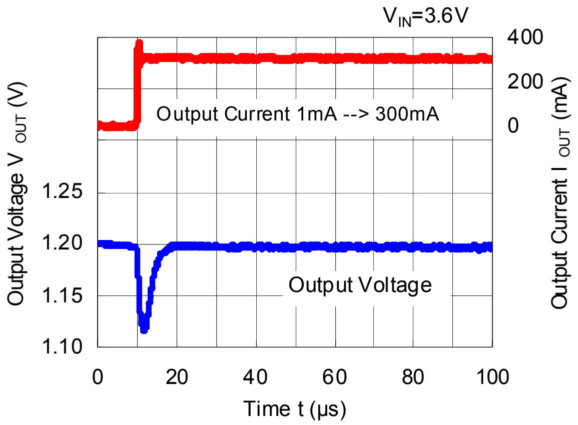
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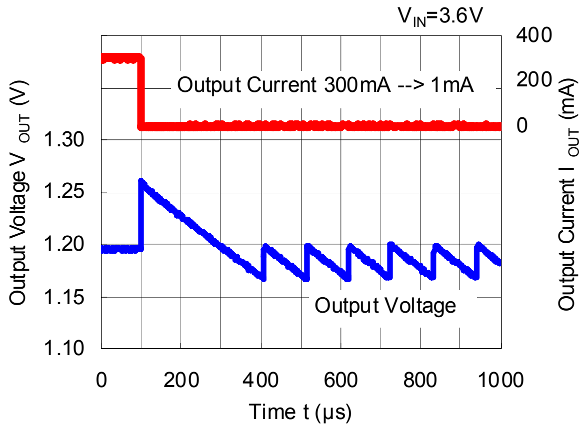
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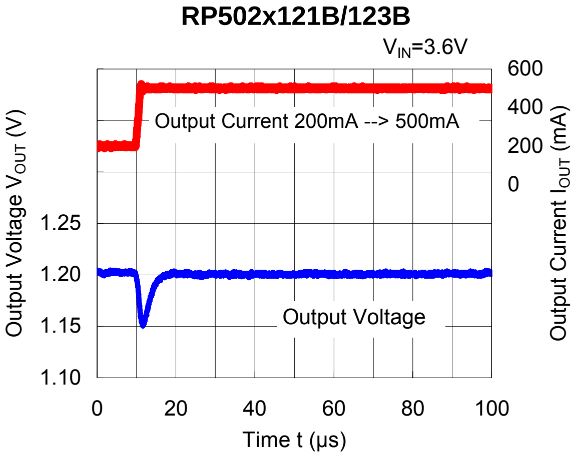
RP502x121B/123B

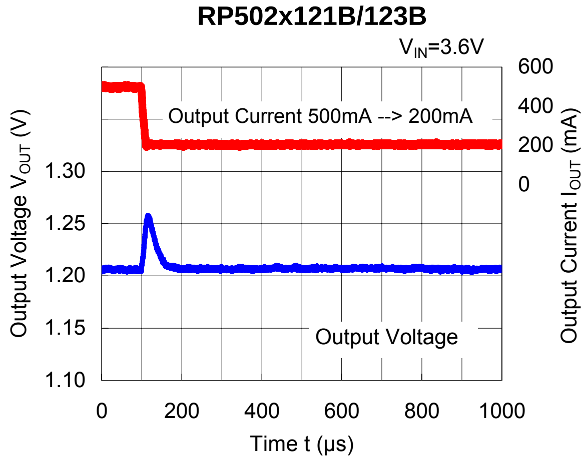


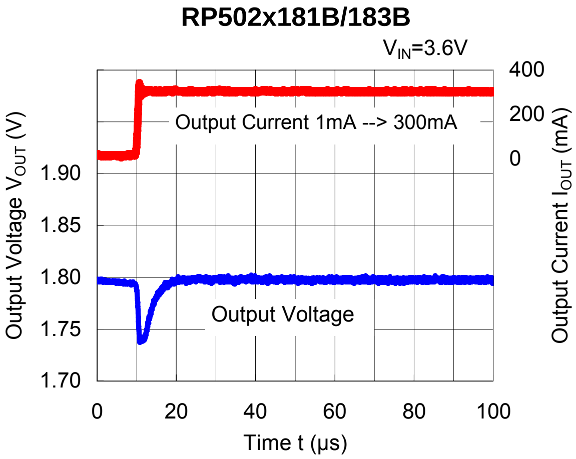
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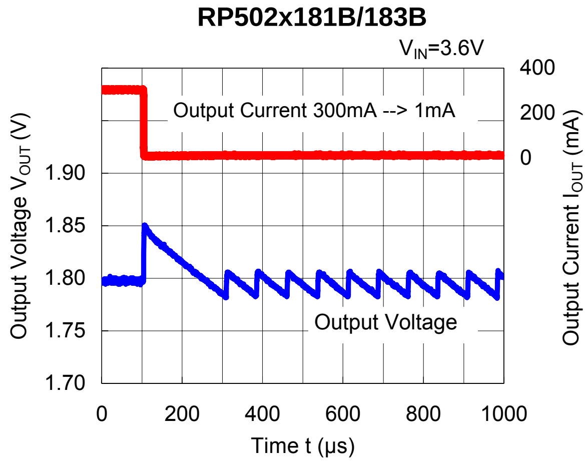


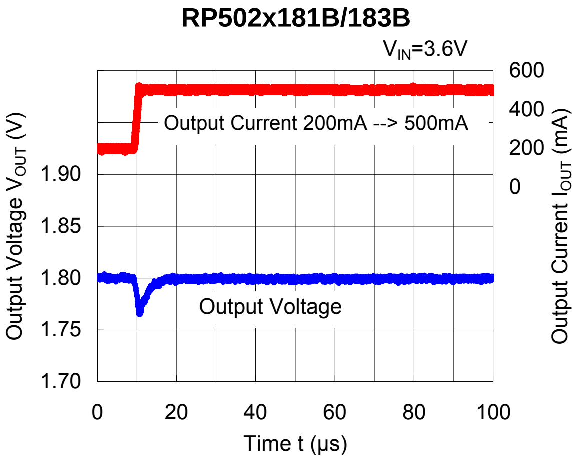
RICOH

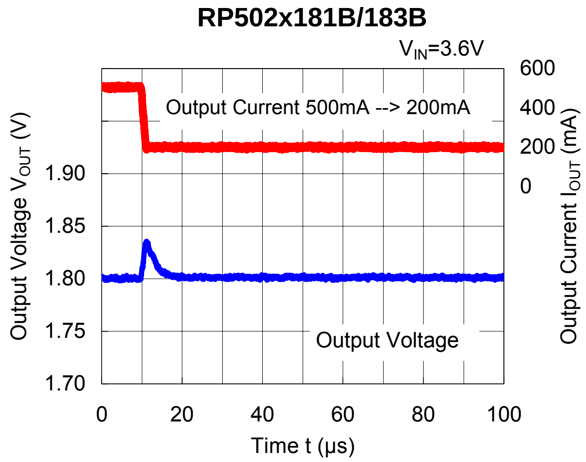

RP502x121B/123B
VIN=3.6V
Output Current 200mA --> 500mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
1.25
1.20
1.15
1.10
600
400
200
0
0
20
40
60
80
100

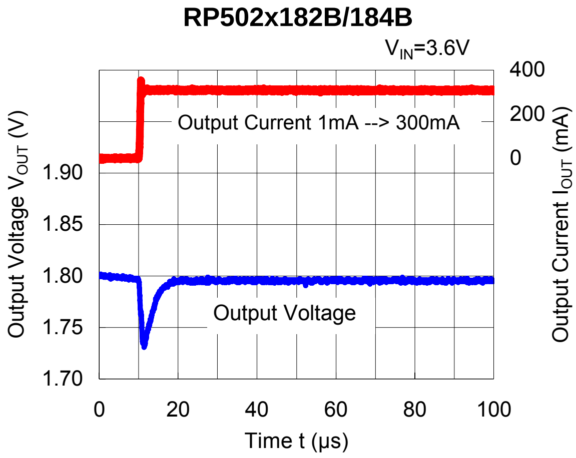

RP502x121B/123B
VIN=3.6V
Output Current 500mA --> 200mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
1.30
1.25
1.20
1.15
1.10
600
400
200
0
0
200
400
600
800
1000

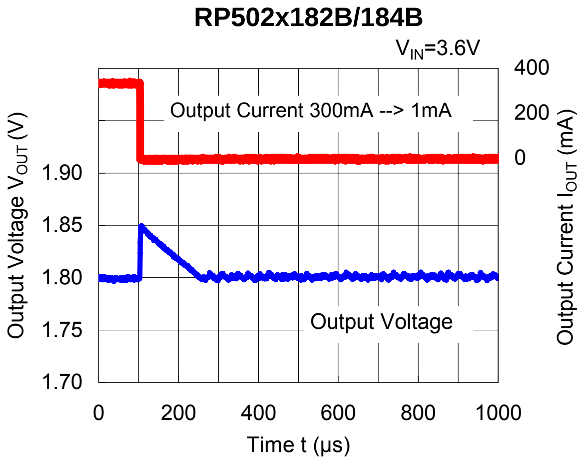

RP502x181B/183B
VIN=3.6V
Output Current 1mA --> 300mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
1.90
1.85
1.80
1.75
1.70
400
200
0
0
20
40
60
80
100

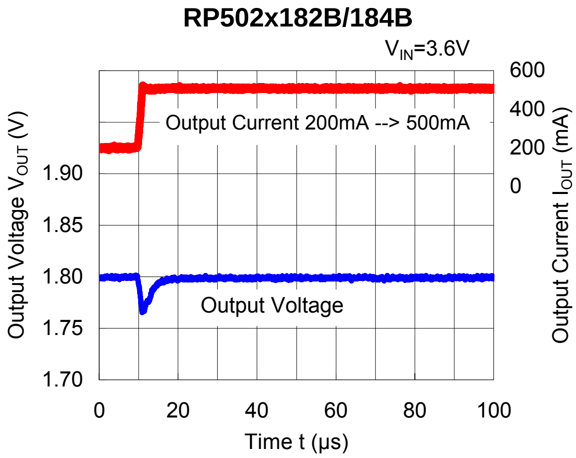

RP502x181B/183B
VIN=3.6V
Output Current 300mA --> 1mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
1.90
1.85
1.80
1.75
1.70
400
200
0
0
200
400
600
800
1000

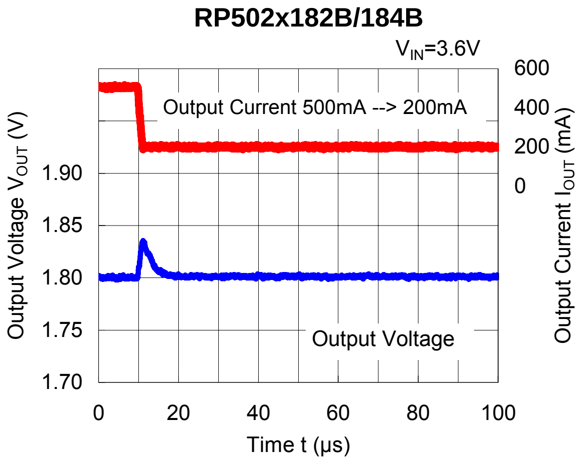

RP502x181B/183B
VIN=3.6V
Output Current 200mA --> 500mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
1.90
1.85
1.80
1.75
1.70
600
400
200
0
0
20
40
60
80
100

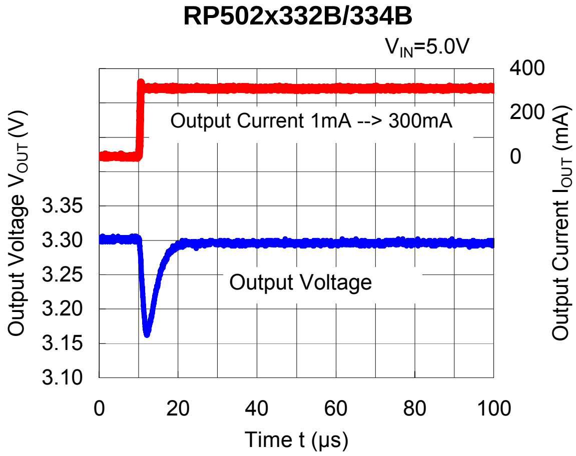

RP502x181B/183B
VIN=3.6V
Output Current 500mA --> 200mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
1.90
1.85
1.80
1.75
1.70
600
400
200
0
0
20
40
60
80
100

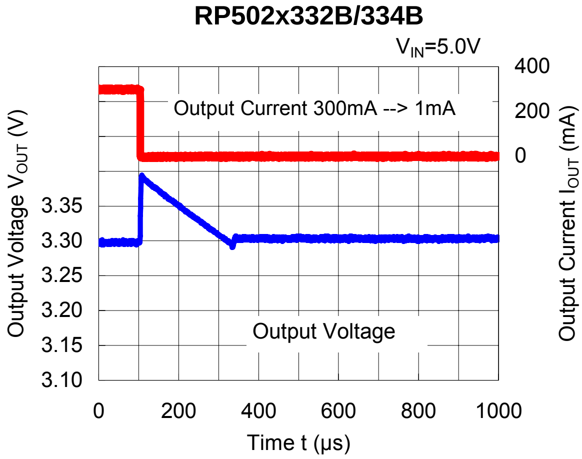

RP502x182B/184B
VIN=3.6V
Output Current 1mA --> 300mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
1.90
1.85
1.80
1.75
1.70
400
200
0
0
20
40
60
80
100

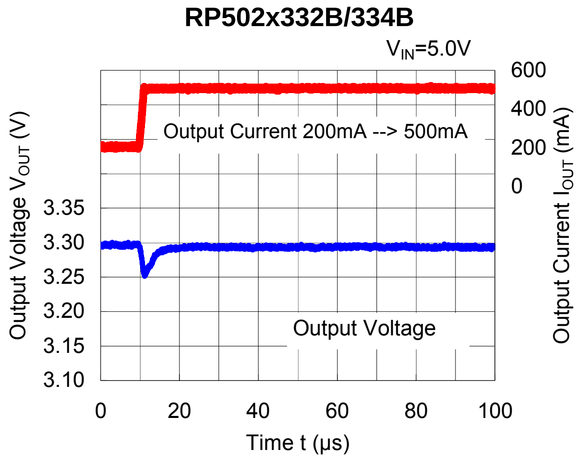

RP502x182B/184B
VIN=3.6V
Output Current 300mA --> 1mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
1.90
1.85
1.80
1.75
1.70
400
200
0
0
200
400
600
800
1000

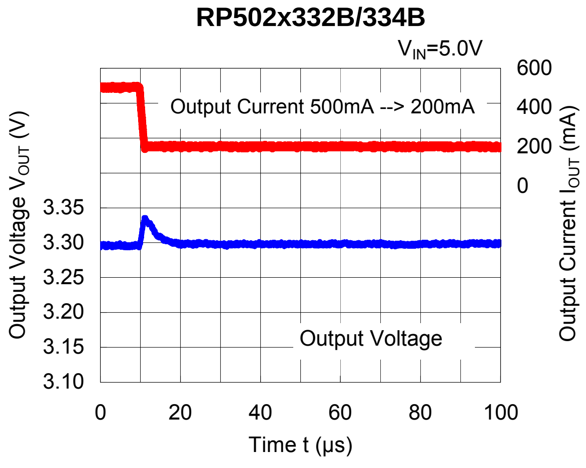

RP502x182B/184B
VIN=3.6V
Output Current 200mA --> 500mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
1.90
1.85
1.80
1.75
1.70
600
400
200
0
0
20
40
60
80
100


RP502x182B/184B
VIN=3.6V
Output Current 500mA --> 200mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
1.90
1.85
1.80
1.75
1.70
600
400
200
0
0
20
40
60
80
100


RP502x332B/334B
VIN=5.0V
Output Current 1mA --> 300mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
3.35
3.30
3.25
3.20
3.15
3.10
400
200
0
0
20
40
60
80
100


RP502x332B/334B
VIN=5.0V
Output Current 300mA --> 1mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
Time t (μs)
3.35
3.30
3.25
3.20
3.15
3.10
400
200
0
0
200
400
600
800
1000


RP502x332B/334B
VIN=5.0V
Output Current 200mA --> 500mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
600
400
200
0
3.35
3.30
3.25
3.20
3.15
3.10
0
20
40
60
80
100
Time t (μs)


RP502x332B/334B
VIN=5.0V
Output Current 500mA --> 200mA
Output Voltage
Output Voltage VOUT (V)
Output Current IOUT (mA)
600
400
200
0
3.35
3.30
3.25
3.20
3.15
3.10
0
20
40
60
80
100
Time t (μs)

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RICOH COMPANY., LTD. Electronic Devices Company

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日本経営品質賞 1999年度受賞

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The Ricoh Group was awarded ISO 14001 certification, which is an international standard for environmental management systems, at both its domestic and overseas production facilities. Our current aim is to obtain ISO 14001 certification for all of our business offices.

RoHS Compliant

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